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INTERNATIONAL GEOPHYSICAL COOPERATION PROGRAM-- SOVIET-BLOC ACTIVITIES

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I. ROCKETS AND ARTIFICIAL EARTH SATELLITES

Translational-Rotational Motion of a Satellite

Until recently, the problem of the translational-rotational motion of a body was artificially divided into two separate problems. Such a procedure of investigation of the problem has a very limited character. In 1958, G. N. Duboshin removed these limitations and formulated the general problem on the translational-rotational motion of a system of bodies. The theoretical and practical importance of such a general problem is evident.

In the present paper, a particular solution of this general problem is given for the practically important case of two bodies, when the satellite is a spheroid and the planet a sphere. A spheroid is considered to be any homogeneous body of rotation which is symmetrical with respect to a plane perpendicular to its axis of rotation. The particular solution derived is applicable to circular motions of the satellite's center of inertia around the center of the planet with a constant angular velocity λ and precessional motion of the satellite's axis around the perpendicular to the plane of motion with a constant precessional velocity $\dot{\psi}$ equal to $\dot{\lambda}$. The satellite also rotates around its axis of symmetry with a constant angular velocity $\dot{\varphi} = \frac{A - C}{C} \dot{\psi} \cos \theta$, where A and C are, respectively, the equatorial and polar moments of inertia of the satellite and θ its nutational angle $0 < \theta < \pi$.

From here $\cos \theta = \frac{C}{A} \frac{r_0}{\dot{\psi}}$, where the constant r_0 is the projection of the angular velocity of the satellite on its axis of symmetry. The angle θ depends on the initial values of the angular velocities $\dot{\psi}_0$, $\dot{\varphi}_0$ and the moments of inertia A and C. Owing to a great possible variety of values for $\dot{\psi}_0$, $\dot{\varphi}_0$, A, C of artificial bodies, we can select these values so that $|\cos \theta| \leq 1$.

For example, assuming C = 0, we find the most simple regular motions of a material segment with an angle of nutation $\theta = \frac{\pi}{2}$. There is evidently no sense in considering the rotation of a segment around itself.

Our result can be applied to the problem on the translational-rotational motion of a rocket around the Earth or Sun, assuming that the rocket is homogeneous and has the symmetry indicated above, and also in the future, when interplanetary space stations (rocketdromes) which have the limiting form of a flattened spheroid (i.e. "saucer" or "disk") are established. ("Particular Solutions of the General Problem of the Translational-Rotational Motion of a Spheroid Attracted by a Sphere," by V. A. Kondurar, Ivanovskiy Power Engineering Institute imeni Lenin; Moscow, Astronomicheskiy Zhurnal, Vol 36, No 5, Sep/Oct 59, pp 890-901)

Position and Period of the Axis of Rotation of Sputnik III

The well-known, almost periodic change of brightness of the carrier rocket of Sputnik III was produced by a rotation of the cylindrical rocket around an axis which was perpendicular to the figure axis. During one complete revolution, there were two brightness maxima when the sunlight was reflected back to the observer. Thus, the times of these maxima depended, on the one hand, on the mutual position of the Sun, rocket and observer and, on the other hand, on the position of the axis of rotation of the rocket. Since the position of the rocket was known, it was possible to determine from the time between maxima the position of the axis of rotation in space and the period.

On the basis of a formula given by Tsesevich (Report of the Conference of the IAU in Moscow, 1958), about 350 photographs were obtained by the Potsdam Astrophysical Observatory and processed by a graphical method at the Babelsberg Observatory. It was found that the axis of rotation slowly changed its position in space and that the period continuously increased. With the graphical method, the position of the axis was determined with an accuracy of about plus-minus 5 degrees; the periods are accurate to within about plus-minus 0.01 second.

At the end of the observation period (about 29 July 1958), the precession of the axis of rotation could be caused only by the gradients of the earth's gravitational field; before that, however, other additional forces of a different origin had to be assumed. The decrease of orbital velocity was caused by the retarding effect of the air drag and by eddy currents which the magnetic field of the earth induced within the rocket.

The deceleration of rotation is related to the acceleration of the orbital motion around the earth according to the following relationship stipulated by the theory:

$$\frac{\Delta P}{\Delta T} = \text{const.}\ \frac{M(L_1^3 + L_2^3)}{a\, v_p^2\, \Theta\, L} \cdot \frac{P}{T} \cdot f\ (\text{geom. data}),$$

where: ΔP and ΔT are the decrease of the period of rotation P and the decrease of the orbital period T in seconds per day; M is the mass of the rocket; Θ is the moment of inertia of the rocket; L is the total length of the rocket; L_1 and L_2 are lengths from the ends of the rocket to its center of gravity; a is the major semiaxis of the satellite orbit; and v_p is the velocity of the rocket at perigee.

The function f depends only on the geometric data of the orbital and rotational motion; it is of the order of magnitude of unity and is only very slightly variable.

If this theoretical value of $\Delta P / \Delta T$ is compared with the average observed value, $\Delta P / \Delta T = \frac{0.0124 \text{ sec}}{3.04 \text{ sec}}$, then, from the difference of the two values, it is possible to obtain the value of the magnetic retardation of orbital motion which, in contrast to air drag, is difficult to explain on the basis of theory. It is assumed here that the retardation of orbital motion is caused solely by air drag. When extreme rocket dimensions are assumed, a maximum magnetic retardation of 0.0075 second per day is obtained.

A detailed description of the investigations is given by P. Notni and H. Oleak in Veroeff. d. Sternwarte Babelsberg (Publications of the Babelsberg Observatory), Vol 13, No 3, 1959 and Vol 13, No 4, 1959. ("The Variation of Brightness of the Carrier Rocket of Sputnik III," by P. Notni and H. Oleak, Babelsberg Observatory; Berlin, Monatsberichte der Deutschen Akademie der Wissenschaften zu Berlin, Vol 1, No 7/10, 1959, pp 394-396)

Rakosliget (Budapest) Space Observation Station Received Lunik II Signals

Signals from the second Soviet cosmic rocket were received by the Rakosliget Space Rocket and Artificial Satellite Observation Station in Budapest. The time of impact of the rocket with the Moon was also determined.

The station is unique, in that it was built through the work of two men, Tibor Horvath, engineer and chief of the station, and Mihaly Gubavy. The station's 30-meter-high tower was built of scrap materials.

The station is located in a room of Horvath's house. Aid in building the station was given to Horvath by the plant in which he is employed, the Fine Chemicals Factory (Finomvegyszergyar).

Tibor Horvath has been working with astronomy and radio for 20 years. His work is recognized in astronomy circles, and proof of his ability can be seen in the request for Rakosliget observations "by the Soviet Space rocket station which launches artificial earth satellites."

The station is reportedly seeking aid for expanding and improving its facilities. According to Gedeon Roka, secretary of TIT[Society for Spreading Scientific Knowledge] Astronomy Group, the group is the nominal owner of the station, but has no funds available for such aid. Roka said financial aid could come only from the Academy of Sciences. However, when contacted, the secretariat at the academy denied any connection with the Rakosliget station. ("The Rakosliget Space Rocket Observation Station Asks for Help"; Budapest, Magyar Nemzet, 14 Oct 59, p 3)

II. UPPER ATMOSPHERE

Zodiacal Light

The results are given of photoelectric observations of zodical light made during October and November 1957 near Aswan, Egypt. The isophotes of zodical light were obtained from observations with yellow and green light filters and also from observations with an interference filter centered at λ 522 mu.

The axis of zodical light lies very near the ecliptic. The decrease in brightness normal to the ecliptic is more rapid to the south than to the north. However, the broadening of isophotes of such an order, as is observed in the middle latitudes, was not detected. The maximum degree of polarization was found to be 22 percent. The color index of zodical light is, on the average, + 0.35. ("Photoelectric Observations of Zodiacal Light in Egypt," by N. B. Divari and A. S. Asaad; Moscow, Astronomicheskiy Zhurnal, Vol 36, No 5, Sep/Oct 59, pp 856-866)

Zodiacal Light Suggested as a Component of Night Airglow

V. G. Fesenkov suggests that zodiacal light can produce some illumination of the atmosphere even when hidden by the horizon. In such a case, the produced effect seems to vary gradually with the azimuth and can produce some enlargement of the observed isophotes of zodiacal light.

The calculation of the absolute value of this effect shows that it is very small, being about 10^{-3} of one thousandth of a star of the fifth magnitude per square degree at a point 10 degrees above the horizon near the ecliptic. ("On Zodiacal Twilights," by V. G. Fesenkov; Alma-Ata, Izvestiya Astrofizicheskogo Instituta, Akademiya Nauk Kazakhskoy SSR, No 8, 1959)

Conditions of the Disintegration of Asteroids Based on Studies of Zodiacal Light

All the properties of zodiacal light can be fully explained by the scattering of sunlight by fine dust particles in interplanetary space. These particles cannot remain indefinitely in space, but must be renewed by means of the continuous inflow of matter from without. This process is the result of the gradual disintegration of asteroids.

With the knowledge of the distribution of asteroids according to the angle of inclination of their orbits, it is possible to calculate isophotes of zodiacal light, assuming a specific distribution law for the density of dust matter in interplanetary space as a function of distance from the Sun, assuming a definite form of scattering index, and assuming that dust matter arises because of the disintegration of asteroids.

Calculations are made for three different scattering indexes, one, purely spherical, two, atmospheric, and three, purely aerosol. The results are similar, but a widening of the isophotes is noted in relation to an increase in asymmetry. Thus, the character of isophotes of zodiacal light depends very little on the type of scattering index, but is fully determined in relation to the distribution of the orbit of the dust particles according to the angle of inclination in relation to the ecliptic.

The isophotes of zodiacal light in all conditions are always narrower relative to the ecliptic if they are assumed to issue from the known distribution of the inclinations of the asteroidal orbits.

The considerable difference noted in the theoretical and observed form of isophotes can be explained only by conditions for the formation of zodiacal light, i.e., by conditions in which a gradual pulverization of asteroids occurred.

Two suppositions for this difference are advanced. One is that the dust originated, not only from asteroids, but also from periodic comets which are characterized by a much wider distribution of orbits according to the angles of inclination to the ecliptic. The other alternative can be that, in addition to the comparatively large asteroids known to us, there exist numerous smaller asteroids also with a wider range in the distribution of orbits according to the angles of inclination. ("Conditions for the Disintegration of Asteroids According to Observations of Pecularities of Zodiacal Light," by V. G. Fesenkov; Alma-Ata, Izvestiya Astrofizicheskogo Instituta, Akademiya Nauk Kazakhskoy SSR, No 8, 1959, pp 3-11)

Some Results of Soviet Studies on Atmospheric Optics Made in Egypt

Measurements of the brightness and polarization of the day sky were conducted by an expedition of the Academy of Sciences USSR working according to the program of the IGY in the Libyan desert about 20 miles south of Aswan on the left bank of the Nile (23 59 N, 32 52 E; elevation, 200 meters above sea level).

The party consisted of Ye. V. Pyaskovskaya-Fesenkova, V. M. Kazachevskiy, and P. N. Boyko of the USSR and Emara Saeda from the University of Cairo.

Observations were made during October-November 1957. It was found that polarization at zenith was considerable, particularly in the afternoon, reaching up to 81 percent. Polarization at an angular distance of 90 degrees from the Sun and in the same almucantar proved to be especially stable in the afternoon. Its orientation coincided very nearly with that theoretically calculated with first-order scattering.

The scattering index determined from the observations along the Sun's almucantar was divided into two components, one, the scattering index in natural rays, and two, the scattering index in polarized rays. In addition, the total scattering index was divided into two other components, one caused by molecular scattering and the second by aerosol scattering. The latter was further divided into that for natural and polarized rays. The maximum of polarization directly observed corresponds to the angle of scattering of 90-100 degrees and for the aerosol component, to the angle of 120 degrees. ("Some Data on Polarization of the Sky in Southern Egypt," by Ye. V. Pyaskovskaya-Fesenkova; Alma-Ata, Izvestiya Astrofizicheskogo Instituta, Akademiya Nauk Kazakhskoy SSR, Vol 8, 1959, pp 82-97)

Studies of the 29-30 September 1957 Aurora

The results of visual and spectrophotometric observations of the 29-30 September 1957 low-latitude aurora conducted in the Zailiyskiy Ala-Tau Mountains in the region of Bolshoye Almatinskoye Ozero (φ = 43.04, λ = 5 hours 7 minutes 50 seconds; altitude, 3,000 meters) are given in an article by Z. V. Karyagina.

Spectral features of this aurora were the strength of the [OI] red line, 6300 + 6364 Angstroms; the presence of the [NI] line at 5200 Angstroms; and the great strength of the N bands.

The article describes the visual observations, gives a description of the aurora's spectrum, explains the method of observation, and tells of the results obtained. ("Low-Latitude Aurora of 29-30 September 1957," by Z. V. Karyagina; Alma-Ata, Izvestiya Astrofizicheskogo Instituta, Akademiya Nauk, Kazakhskoy SSR, Vol 8, 1959 pp 68-78)

R. Kh. Gaynullina presents the results of a spectrophotometric study of the red part of the spectrum of the aurora of 29-30 September 1957 for the 6300 and 6364 Angstrom lines, in a separate article. ("Spectrophotometry of the Red Part of the Spectrum of the Low-Latitude Aurora of 29-30 September 1957," by R. Kh. Gaynullina; Alma-Ata, Izvestiya Astrofizicheskogo Instituta, Akademiya Nauk Kazakhskoy SSR, Vol 8, 1959, pp 79-81)

Soviet 1,300 Millimeter Telescope

The assembly of a mirror-lens, wide-angle telescope has been completed at the Leningrad Opticomechanical Plant. The Schmidt-system telescope was developed by plant engineers under the supervision of M. Afanas'yev and P. Dobuchin.

The mirror has a diameter of 1,300 millimeters. Its principal feature is the capability, owing to a wide-angle optic, to conduct simultaneous observation of large portions of the sky. ("Wide-angle Telescope"; Moscow, Izvestiya, 25 Nov 59, p 6)

III. METEOROLOGY

Chinese Launch Weather Balloons 23.6 Kilometers High

In March 1959, the Observatory of the Central Weather Bureau of China launched its weather balloons daily at 0700 and 1900 hours, respectively, to an average height of 23,640 meters. This altitude compares with 14,952 meters average height in November 1958, for the same hours. The increase in altitude reportedly was achieved by giving the China-manufactured, 350-gram balloons the following four-step treatment:

1. Soak thoroughly 10-15 minutes in warm (80-90 degrees Centigrade) water. Airdry away from direct sunlight and draft.

2. Warm in oven at 60-70 degrees centigrade for one to 2 hours. Turn inside out and leave in oven another one to 2 hours.

3. Repeat Step 1, but soak 5 minutes longer.

4. Soak 5 minutes in 5:1 ethanol-water solution. Leave in air-tight container 4-6 hours. Turn inside out, soak again, and leave in container another 2-4 hours.

After the above treatment, the balloons were 10-20 centimeters longer and weighed 20-40 grams less. (Peiping, T'ien-ch'i Yueh-k'an (Weather Monthly), No 5, 1959; pp 46-47)

IV. GEOMAGNETISM

Importance of Phase Characteristic of Electrical Field in Electromagnetic Soundings

The purpose of this work was to ascertain the rational range of frequency for certain types of geoelectric profiles and to make a quantitative estimate of the resolving capacity of alternating current in such cases, i.e., to determine the sensitivity of various elements of the field (amplitude and phase characteristics of the magnetic and electric components) in relation to the thickness of the nonconducting interstitial stratum and the effect of the shielded structures.

Alternating electromagnetic fields afford the possibility of plotting the soundings of structures which are shielded by interstitial nonconducting strata. Thin nonconducting layers influence neither the amplitude nor the phase of the vertical component of the magnetic field. Rather thick layers of nonconducting strata, however, essentially influence the vertical component of the magnetic field; the thickness of these layers can be determined on the basis of both amplitude and phase. It is also possible to determine the boundaries of the underlying basement.

Any attempt at interpretation on the basis of the magnetic component of a multilayer cross section containing interstitial nonconducting layers of moderate thickness which, in the first approximation, is assumed to be homogeneous, can lead to too low values for the total thickness.

In the case of the electrical field, the nonconducting layer is of great importance. In the presence of a shielding interstitial layer, the curves of the apparent (in relation to distance) specific resistance do not have a horizontal, but rather an inclined asymptote. The angle of inclination depends on the thickness of the shield and parameters below the layers.

The presence of nonconducting interstitial layers has an even greater influence on the phase characteristic of the electrical field. In the cases investigated, the phase curves showed greater divergences than the amplitude curves; the phase curves "sense" better the thickness of the shield and underlying basement. ("On the Resolving Capacity of the Method of Electromagnetic Sounding In the Presence of Interstitial Nonconducting Strata," by A. N. Tikhonov, D. N. Shakhsuvarov, and Ye. V. Rybakova, Institute of the Physics of the Earth, Academy of Sciences USSR; Moscow, Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 10, Oct 59, pp 1,455-1459)

V. ARCTIC AND ANTARCTIC

Observation Materials of Severnyy Polyus-6 Being Processed

The drift station Severnyy Polyus-6, which operated in the Arctic from April 1956 to September 1959, was an excellent base for scientific research in the fields of oceanography, aerometeorology, geology, and geophysics. The station scientists made a number of important geographical discoveries. The discovery of a large submarine elevation, located among great ocean depths north of Zemlya Frantsa Iosifa, was of special interest. The smallest depth of the Arctic measured above this elevation was recorded at 730 meters. Prior to this discovery, the smallest depth in the Central Arctic Basin was considered to be 954 meters, as recorded above the Lomonosov Range.

The observation materials of Severnyy Polyus-6 are now being processed in the Arctic and Antarctic Institute. ("Reports by Polar Workers on the Ice Island," Moscow, Vodnyy Transport, 21 Nov 59)

New Soviet Polar Station Established in Arctic

During 1959, six Soviet polar scientists were assigned the task of opening a new polar station on Ostrov Viktoriya in the Arctic. These scientists are V. Buchin, V. Vasil'yev, A. Knyazev, E. Zatolochin, D. Pereverznev, and A. Sorokin.

This uninhabited Soviet island is located in the strait between Zemlya Frantsa Iosifa and Spitsbergen. The island was first discovered in 1898. For 30 years after that, no one approached it. Later on, some foreign and Soviet ships came near the island, and a Norwegian expedition landed there for a temporary period.

In 1932, the Soviet Oceanographical Institute sent a special expedition headed by the polar explorer N. Zubov to Ostrov Viktoriya. The Soviet seamen raised the USSR flag, explored the island thoroughly, and determined its exact location and dimensions. The island has an area of about 8 square kilometers and is almost completely covered by ice. Only in its northeast part, is there a section of the surface which is ice free.

Viktoriya is the most western island of the Soviet Arctic. Scientists have long been attracted by this region.

At the end of August 1959, the Lena left Arkhangel'sk on an Arctic voyage, carrying equipment for construction of the new polar station. The ship reached the island during the latter part of September. Three prefabricated huts were set up, radio masts were erected, and a meteorological platform was installed. ("On the Far-Away Ice-Covered Land," Moscow, Vodnyy Transport, 24 Nov 59)

Radio Contact With Viktoriya

A correspondent of Sovetskaya Rossiya established radio contact with Vasiliy Petrovich Bugin, chief of the polar station on Ostrov Viktoriya, a tiny island in the Arctic, north of the 81st parallel. Only six men are wintering at this station. The state flag of the USSR was hoisted on Viktoriya on 1 November 1959. This marked the official opening of the new Soviet polar station. Since that time, weather reports are transmitted by the Viktoriya radio station. The construction of buildings and installation of complex equipment and instruments was completed despite heavy winds, snowstorms, frost, and the darkness of the polar night. ("We Receive Radio Reports," Moscow, Sovetskaya Rossiya, 7 Nov 59)

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